CROPS RESEARCH IN THE SOVIET UNION

REPORT OF A TECHNICAL STUDY GROUP

Agricultural Research Service

UNITED STATES DEPARTMENT OF AGRICULTURE

CONTENTS

Washington, D. C. Issued August 1959

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. Price 25 cents

FOREWORD

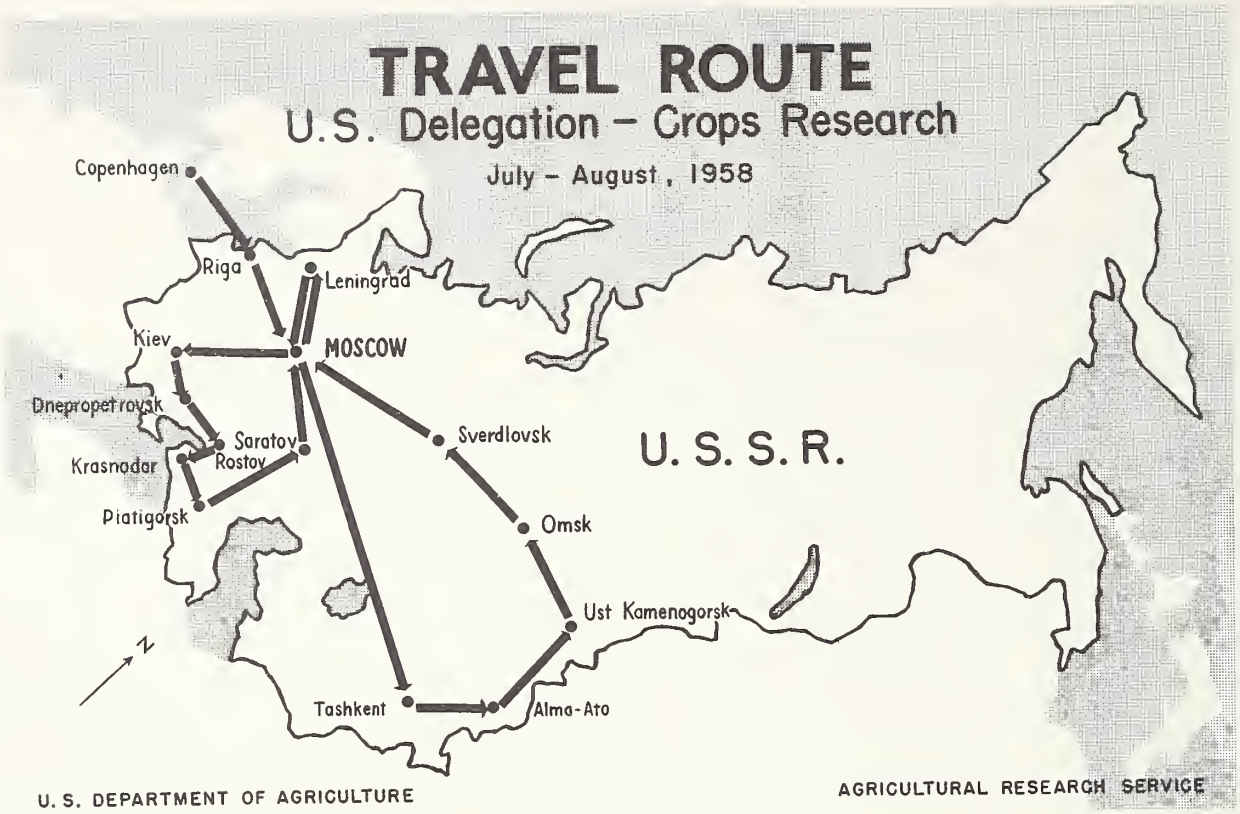
An Agreement, concluded on January 27, 1958, between the Governments of the United States of America and the Union of Soviet Socialist Republics, provides for exchanges in the cultural, technical, and educational fields during 1958 and 1959. This Agreement is regarded as a significant first step in the improvement of mutual understanding between the peoples of the two countries.

Agriculture, which plays an important role in the national economies of the two countries, was specifically included in the Agreement as a field for exchange of specialists. The United States Department of Agriculture accordingly sent to the Soviet Union in 1958 six technical study groups of specialists in the following subjects: Agricultural Economics; Agricultural Crops; Soils and Water Use; Veterinary Science; Mechanization of Agriculture; and Cotton Growing and Plant Physiology. In 1959 it is planned to send three additional study groups in the following fields: Forestry, Lumbering, and Millwork; Sheep Raising; and Biological Control of Agricultural Pests.

The Soviet Union in turn sent to the United States in 1958 six delegations of specialists in the following subjects: Farm Mechanization; Hydro-Engineering (Irrigation) and Reclamation; Animal Husbandry; Cotton Growing; Agricultural Construction and Electrification; and Veterinary Science. In 1959 three additional Soviet teams are expected in the following fields: Mixed Feeds; Forestry, Lumbering, and Millwork; and Horticulture.

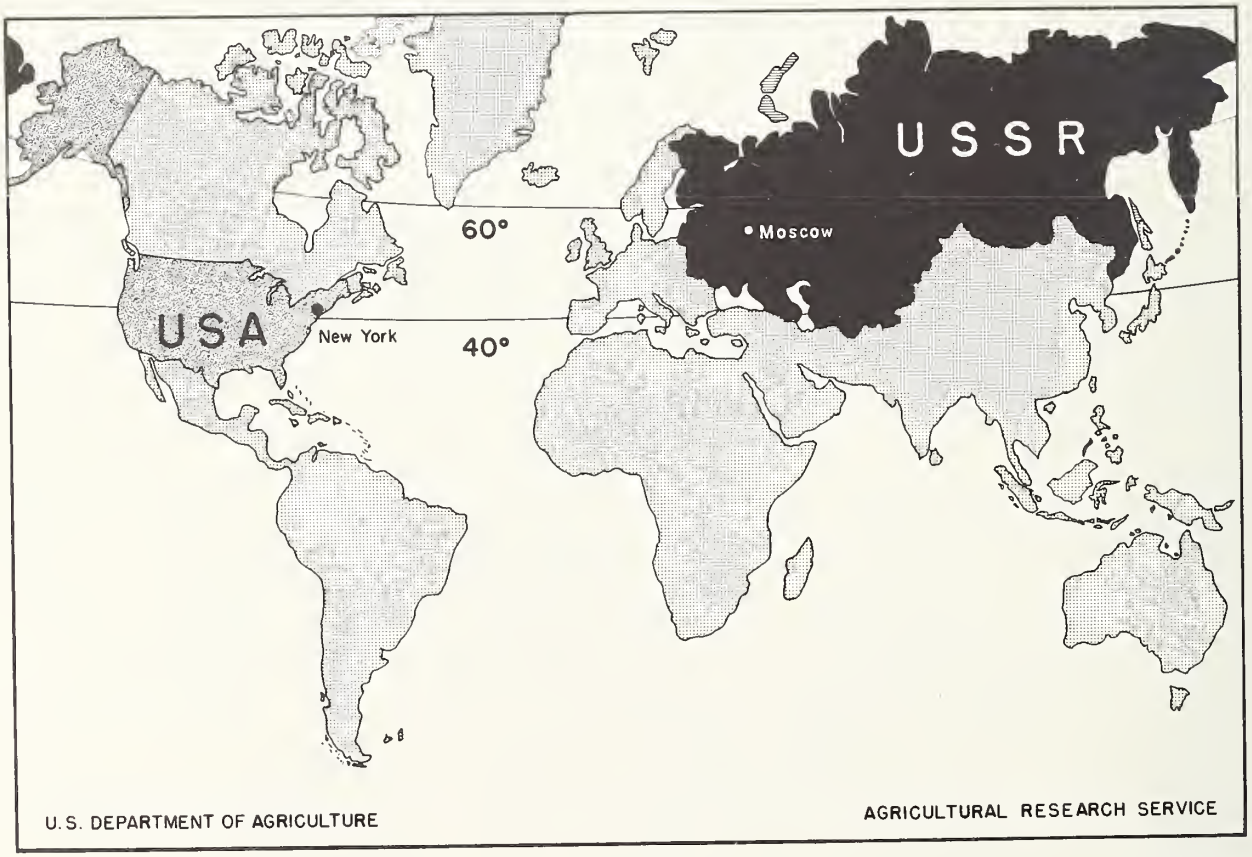
Each United States exchange study group, on completion of its assignment, prepared a report for publication. Crops Research in the Soviet Union represents the report of the Agricultural Crops exchange group and was prepared by Herman A. Rodenhiser, Group Leader, Carl O. Erlanson, John R. Magness, and Ivan A. Wolff, Agricultural Research Service, United States Department of Agriculture; and Herbert H. Kramer, collaborator, Purdue University Agricultural Experiment Station.

GUSTAVE BURMEISTER
Assistant Administrator
Agricultural Trade Policy and Analysis
Foreign Agricultural Service



DN-1710, 1710-A

Travel route of Agricultural Crops exchange group in the Soviet Union, 1958.



DN-1711

Comparison of land areas of North America and the Soviet Union between 40° and 60° N. latitude. Low temperatures and a short growing season in the Soviet Union limit production of many crops.

CROPS RESEARCH IN THE SOVIET UNION

Report of a Technical Study Group

INTRODUCTION

The Agricultural Crops group that visited the Soviet Union from July 15 to August 17, 1958, was mainly interested in an assessment of present research in the Soviet Union in fields of crop breeding, crop physiology, pest control, and crop utilization.

During the course of the visit the group traveled about 7,000 miles and the entire trip was within 40° to 60° N. latitude (see maps, p. iv). The group visited various places in the Republics of Russia, Ukraine, Uzbek, and Kazakh, as well as the Krasnodar and Stavropol districts and western Siberia. A detailed itinerary is presented in table 1. The exchange group visited 28 research institutions, including All-Union (Federal) and Republic institutes and experiment stations. About a dozen collective and state farms were visited to note the practical progress in crop production and the extent and rate of application of research findings to practice.

Aside from a few days' visit at Tashkent and Alma-Ata with their oasis-type agriculture, the itinerary of the group was entirely in the natural grasslands regions of the U.S.S.R. Agriculturally, it is by far the most important region and is the area where one finds the greatest concentration of research institutions devoted to agricultural problems. It corresponds to the northern part of the Great Plains region of the United States and adjacent Canada, but the Russian region is at least 10 times larger. It is a flat to slightly rolling country traversed by some of the longest rivers in the world.

Precipitation is relatively low over the whole region and temperatures run to extremes. Climatic data from a few locations visited will serve to characterize the region (table 2).

It is a region ideally suited for the production of wheat and other small-grain cereals as are the northern Great Plains of the United States and Canada. The degree to which other agricultural production can be adapted to this vast area is a major problem faced by Russian agricultural research workers.

In comparing the agricultural practices of the United States with the Soviet Union, we saw much in our hasty observation that appeared inefficient in Soviet production practices. In many instances further study probably would have demonstrated that such lapses in good practice are borne of present necessity rather than of careless planning. The need for regional self-sufficiency, due to the present lack of adequate transportation, can explain many crop anomalies. The need to employ large peasant populations on farms because they cannot yet be absorbed in urban industries may explain the incongruous mixtures of primitive farm practices and highly modern mechanized agriculture.

Throughout the trip the group was treated with the utmost courtesy and hospitality. The agricultural officials who made our arrangements and assisted us through the complexities caused by language barriers did their best to show us what they thought we wanted to see. If our notes seem inadequate, we can only plead that too much was seen and heard too rapidly to absorb in great detail. We chose to travel as widely as possible, but admittedly, in the time allotted, our itinerary was too full. There were too many people to visit, too many formal dinners to attend, too many production statistics to consider, and too little time for discussion of research projects under way. Too many collective farms and too few experiment stations were visited. The results of our observations that follow are summarized by crops and to a limited extent on a subject-matter basis.

CEREAL GRAINS

Wheat

Wheat is the most important of the small-grain crops produced in the U.S.S.R. Of approximately 320 million acres producing grain crops, 155 million acres, or 48.3 percent, are in the four classes of wheat--

TABLE 1.--Itinerary of Agricultural Crops exchange group in U. S. S. R., 1958

Date	City	Institution or farm visited
July 14	Moscow	
15	..do.....	(American Embassy. (Ministry of Agriculture. (Agricultural and Industrial Exposition.
16	..do.....	Agricultural and Industrial Exposition.
17	..do.....	(Ministry of Grain Products. (All-Union Lenin Academy of Agricultural (Sciences.
18	..do.....	(Institute of Genetics (Lysenko). (Gorki Leninskie Experiment Station.
19	..do.....	(All-Union Institute of Grain Production and (Processing. (Timiryazev Agricultural Academy.
20	..do.....	Kremlin.
21	Kiev.....	Ukraine Ministry of Agriculture.
22	..do.....	(Ukraine Academy of Agricultural Sciences. (Collective Farm Rodina. (All-Union Sugar Beet Institute.
23	..do.....	(All-Union Mironovskaya Experiment Station. (Collective Farm.
25	Dnepropetrovsk.....	(Sinelnekova Experiment Station. (All-Union Institute of Corn Research. (Collective Farm Lenin.
27	Krasnodar.....	(Krasnodar Research Institute of Agriculture. (All-Union Institute for Oil-Bearing Crops.
28	..do.....	(Collective Farm Kirov. (Collective Farm.
29	..do.....	(Northern Caucasian Institute for Horticultural (Crops and Grape Growing. (All-Union Institute of Tobacco.
30	Krasnodar to Piatigorsk.....	Collective Farm Stalin.
31	Piatigorsk.....	(Collective Farm Proletarskaya Volya. (Botanical Garden.
Aug. 1	Saratov.....	(Research Institute of Agriculture for the (Southeastern Area.
2	Ershovsk.....	(State Farm Dekabrist. (Collective Farm 18th Partsjezd.

Table 1--Continued

Date	City	Institution or farm visited
Aug. 3	Saratov to Moscow to Tashkent.	
4	Tashkent.....	(Uzbek Academy of Agricultural Sciences. (Shreder Research Institute of Horticulture and Grape Growing.
5	..do.....	(Institute of Cotton Genetics. (Ak-Kavakskaia Experimental Station. (Collective Farm Sverdlov.
6	..do.....	(Uzbek Ministry of Agriculture. (All-Union Institute of Plant Chemistry.
6	Alma-Ata.	
7	..do.....	(Kazak Ministry of Agriculture. (Kazak Academy of Agricultural Sciences. (Collective Farm Gornyi Gigant. (Alma-Ata Plant Breeding Station.
8	Alma-Ata to Omsk.	
9	Omsk.....	(Siberian Research Institute of Agriculture. (State Cattle-Breeding Farm.
10	..do.....	(Glass-house Farms. (Collective Farm Chapaev.
11	Omsk to Leningrad.	
12	Leningrad.....	All-Union Institute of Plant Industry.
13	..do.....	(Komorov Institute of Botany. (All-Union Institute of Plant Protection.
15	Moscow.....	(All-Union Ministry of Agriculture. (American Embassy.
17	Left Moscow and the U.S.S.R.	

TABLE 2.--Average high and average low temperatures and precipitation in listed locations, U.S.S.R.

Location	Temperature		Average yearly precipitation
	Average absolute maximum	Average absolute minimum	
	°F	°F	*Inches*
Kiev----------	97.3	-22.0	23.2
Dnepropetrovsk---	103.3	-32.4	17.5
Omsk----------	102.0	-56.0	12.1
Rostov----------	102.0	-19.0	17.9

hard red winter, soft red winter, hard red spring, and durum. During the period 1928-56 the wheat area was increased by 85.75 million acres.[1] Data were not obtained on the relative acreages for each wheat class, but wheat is grown from the Crimea in the south to as far north as latitude 58°. As pointed out by Volin,[2] winter wheat is grown primarily in the Ukraine, Crimea, in the northern Caucasus, and in the irrigated area of Central Asia and Transcaucasia. The spring wheat belt is in the Middle and Lower Volga Basin, the Urals, western Siberia, and Kazakhstan.

During 1958 better than normal weather conditions prevailed throughout the principal wheat-growing areas; consequently, it appears that in the areas visited, wheat, as well as other grains, were observed under better than average conditions. At many of the collective farms winter wheat yields were reported to average 30 centners per hectare, or 45 bushels per acre. Our estimates of yield in the best fields observed were approximately 8 to 10 bushels below this figure. Estimates of spring wheat yields averaged 15 bushels per acre.

At each of the institutes visited we were informed that research is being conducted for improvement of yield, quality, disease and insect resistance, drought resistance and hardiness for all cereal grains. Undoubtedly, a great many varieties and selections of both spring- and winter-type wheats are available in the Soviet Union from worldwide collections made originally by N. I. Vavilov and others. Some wheats have been selected and used as parent stocks in conventional-type breeding programs and the segregates tested to determine their suitability for the various production zones. The 300 varieties of wheat grown in the U.S.S.R. are about equally divided between winter and spring classes. In general, the winter wheat varieties observed were of the Ukrainka type for the western area, and possibly a selection of Gastianum in the areas of lighter rainfall. Marquis, Thatcher, Kanred, Klein 33, Biencedor, Lutescens, Erythrospormum, Caesium, Milturum, Kitchener, and Triticum timopheevi were most commonly referred to as parent stocks in their breeding program for resistance to disease and drought.

The durum wheats, grown entirely in the spring grain area, were observed as far north as Omsk. No definite figures on total production were obtained, but it was generally stated that about 20 to 25 percent of the spring wheat acreage was in durum varieties. The stands observed in 1958 were for the most part light and the yields low, which were attributed to late-spring frosts. Leaf rust was the only disease of consequence noted. It was stated at the Ministry of Grain Products in Moscow that they use a mixture of 70 percent durum with 30 percent soft red winter wheat in the manufacture of macaroni.

At the Siberian Research Institute of Agriculture we were informed that the following wheats had been developed at the Omsk station: Hard red spring varieties--Milturum 321 and 553, Caesium 111, and Albidum 3700; durum wheat varieties--Gordieforma 10, Gordieforma black spike, and Graecum 176. In the development of the Siberian wheats several methods of improvement were employed:

1. Interspecific hybridization.--Caesium 94, adopted in 1956 from a cross between Caesium 117 (T. vulgare) × T. dicoccum. It was reported to be resistant to loose smut.
2. Intervarietal crossing.--Milturum 553, resulting from a cross of Milturum 321 × Kitchener. It was adopted in 1938 and is now grown on 10 million acres.
3. Individual plant selection.--Caesium 111 and Albidum 3700 were selected from a local variety.
4. Conversion of winter to spring wheat in accordance with the following procedure.--(a) Plant 50 square meters very late in fall or early in spring to get vernalization; (b) next year plant at the normal time for spring wheat (mixture of spring and winter types present); (c) third year wheat usually breeds true for spring habit.

Considerable effort is being made to provide clean and relatively pure seed for growing on the collective farms. Once a new variety is developed at an experiment station or so-called seed farm, it is increased on one or more of the collective or state farms in the district for which the

[1] U.S.S.R. Council of Ministers Central Statistical Board. Forty years of Soviet power in facts and figures. 319 pp., illus. Moscow. 1958. [In English. Translated by Foreign Languages Publ. House, Moscow.]

[2] Volin, Lazar. A survey of Soviet Russian agriculture. U. S. Dept. Agr. Monog. 5, 194 pp., illus. 1951.

variety is adapted. When sufficiently increased, the variety is distributed by a government agency to the various collective farms for commercial production. Cleaning operations with winter wheat were observed at a seed farm in the Ukraine, and aside from what appeared to be a trace of varietal mixture, the operations were adequate. However, we observed approximately 20-percent mixtures in two fields in the general vicinity of this station, sown with "new seed" only 2 years after increase and distribution by the Government.

Leaf rust, stripe rust, stem rust, loose smut, and stinking smut are the primary diseases for which the Soviet officials are attempting to breed resistant varieties. We found leaf rust in every field of winter and spring wheat examined, varying in severity from 5 to 100 percent, with 60 to 100 percent of the crop usually infected. The wheat had already been harvested in the areas where stripe rust is most prevalent. However, we were told that in some years nursery material and commercial fields suffered heavy losses from this rust. Stem rust infection was fairly general but light in all areas except at one station near Alma-Ata, where 60 percent infection was observed on the necks of wheat in the medium-dough stage. A late planting of barley as far north as Omsk was completely destroyed with stem rust, and it is our general conclusion that the inoculum of stem rust is not present sufficiently early in the spring to cause heavy infection and appreciable losses. Loose smut is common; attempts are being made to breed for resistance, but so far with only partial success. Bunt, or covered smut, is reasonably well controlled by seed treatment; however, the problem is becoming more complicated with the development of dwarf smut found for the first time in 1958 in the northern Caucasus area and in Armenia in 1950. Physiologic races of the bunt fungus are recognized and are being studied on the basis of cultural characteristics, spore color, and pathogenicity.

The problem of physiologic specialization in the rusts in relation to the breeding program for development of resistant varieties is recognized by research workers at the various institutes. However, little has been done on the identification of races since World War II. Prior to the war, 24 races of Puccinia triticina were identified, 13 of which were important; namely, 9, 10, 13, 17, 19, 20, 21, 24, 31, 53, 64, 65, and 77. Races 20 and 65 were most prevalent, and following in order, 10, 64, and 77. The project has now been reactivated and this year races 6, 21, 27, 44, and one similar to 130 have been identified from collections in the Ukraine, and 42, 116, and 144 from the northern Caucasus region. It appears that no effort is being made to reactivate a program for the identification of races of stripe rust, but the Russians plan to give some attention to the identification of races of black stem rust. Studies to determine the origin of races of leaf rust are being made by investigators on M. S. Dunin's staff at Timiryazev Agricultural Academy. As a result of anastomosing hyphae of different races, the investigators have obtained new races of leaf rust differing from either parent. In most instances a loss of virulence resulted from recombination of nuclei, but two races have been obtained that were more virulent than either of the parent cultures. No observations were made on the nuclear condition of the hybrids.

Many articles have appeared in the Russian literature regarding perennial wheat. At present, it is of little importance in their production program and is being grown only on small scale in Estonia, near the Urals, and just north of Moscow. At the Research Institute of Agriculture for the Southeastern Area (Saratov) it was stated that more than 20 years ago experimental work was done on this crop, but perennial forms were not considered valuable and the work was abandoned.

Wheat Milling and Quality Evaluation.--The All-Union Institute of Grain Production and Processing at Moscow might be compared in a general way with the Wheat Quality Laboratories of the U. S. Agricultural Research Service, but the Russian program and objectives are broader and include grains other than wheat. The particular installation of the Institute visited was concerned with wheat only. The stated aim of the Institute is "to increase the production and processing of grain crops in the entire Soviet Union." In the discharge of this function the Institute evaluates crop varieties, establishes grain standards, develops and applies methods for quality control, and studies methods of grain preservation in storage and new methods of distributing, cleaning, drying, and ventilating grain crops. To accomplish this function the Institute has a number of field stations in the different

Republics. It was stated that the total capacity of Soviet flour mills is twice that of the United States. This Institute is financed by the Ministry of Grain Products. Before a new variety of wheat is released, samples are evaluated for milling and baking quality at this Institute.

The staff seemed well acquainted with both U. S. and Canadian grain standards. U.S.S.R. standards are close to those of the United States. Classification of wheat types in the U.S.S.R. is only slightly different from that in the United States.

We inspected their experimental flour mill, which has a total capacity of 120 tons a day. Three types of flour are produced with respective ash contents of 0.5, 0.75, and 1.25 percent. Only the 1.25 percent grade is vitaminized, additives per kilogram being 3.5 mg. vitamin B_1, 3 mg. B_2, and 20 mg. nicotinamide. The mill is completely automated and pneumatic. There are 6 breaks and a total of 154 mill streams. Flours are made with 75 and 78 percent extraction rate. Tempering is to 15.0 to 15.3 percent moisture content. (At the Ministry of Grain Products, Moscow, tempering was said to be 15 to 15.5 percent H_2O for soft wheat; 17 percent for hard wheat.) No bleach is employed for the reason that they like a slightly yellow flour. The mill contained some fairly old equipment, but the building was light, airy, nicely painted, and completely dust-free. Each machine was individually driven by its own motor in the screen room.

In the evaluation laboratory we saw a Hungarian-built apparatus for measuring dough properties that recorded a graph similar to that obtained on a Farinograph, using 15 gm. flour and 7.5 gm. water. Color was determined colorimetrically using a wavelength of 420 mμ. The Soviet-built equipment is designed to measure flour samples at normal moisture content. The flour sample is placed in a metal ring about 2 inches in diameter that rests on a sheet of heavy paper. After compacting in some way, the sample is placed in the instrument and read. The method was preferred to the Kent-Jones equipment. Also a meter is attached for continuous measurement of color in the mill stream. Although no bleach is used, there is apparently some concern for brightness. Loaves of bread were shown, but we did not see the baking laboratory. The bread was denser, coarser, and less uniform than American white bread. The emphasis on ash content was shown by the several muffle furnaces we saw in the hood and the numerous analytical balances. The staff stated that they have instant mixes, which are sold in special stores. The mixes are called "half-fabricated" products. "Micro" facilities are available for using 10 kg. lots of flour. Bromate is used in baking, if needed.

Wheat quality evaluations were also conducted at a number of other locations. No others visited, however, had facilities as extensive as at the All-Union Institute of Grain Production and Processing.

At the All-Union Sugar Beet Institute at Kiev, research is carried out on cereals, as well as beets and a number of other crops. Quality tests on wheat include a modification of a published procedure of Pelschenke (on 2 gm. wheat) (cf. Wheat Meal Fermentation Time Test, American Association of Cereal Chemists Cereal Laboratory Methods, ed. 6 (1957)), percentage protein determination, and a baking quality test using 3 kg. of wheat. They said the Alveograph was in use. Ash was determined on flour, but color was not determined except visually. Sugar and bromate were added during the baking process. Loaf volume of bread was measured. Although the Russians seemed to prefer high loaf volume, their bread is rather dense.

At the Siberian Research Institute of Agriculture wheat quality was evaluated by baking tests. A photograph was shown comparing loaves baked from five different wheat varieties. However, each loaf was baked from flour made with a different total extraction rate (varying from 71 to 76 percent) and a different protein content (14 to 18 percent for the lowest, to 17 to 21 for the highest, we were told). It was difficult to ascertain through the interpreter how conclusions could be drawn with so many variables, but apparently loaf volume is considered important and an index of how satisfactory a wheat variety is. No micro-milling procedures were used. A Russian-built Wolf mill (minimum of 3 kg. wheat) was used for milling. Both 100-gm. and 300-gm. loaves were made. The 100-gm. loaves were baked 17 to 19 minutes and the 300-gm. size for 21 minutes at 200° C. The equipment seen included an automatic moisture meter and Kjeldahl equipment. The moisture meter resembled the American-

built "Cenco" meter. We were told that their Alveograph was broken. Gluten quality was measured qualitatively by the length of strand in inches before breaking upon stretching. Their equipment was not so modern as that at the All-Union Institute of Grain Production and Processing.

At the All-Union Institute there were also routine analytical laboratories for soils, milk, and meat products.

At the biochemical laboratory of the All-Union Institute of Plant Industry at Leningrad, quality evaluations on wheat flour included a study of gassing power, determined on a 10-gm. sample mixed with 3 ml. of 5-percent salt solution and 3 ml. of water containing yeast.

Total Usage and Protein Content of Flour.--At the Ministry of Grain Products, Moscow (somewhat like the Agricultural Marketing Service of the U. S. Department of Agriculture), protein contents of Soviet flour were stated as follows: Flour protein is not less than 12 to 14 percent. Best flour grade has 14 to 16 percent protein, while the highest bread flour has 18 percent. Macaroni flour has 18 to 20 percent protein. Eighty to 85 percent of all bread in the U.S.S.R. is made from wheat flour; the rest from rye.

Wheat Berry Without Crease.--Upon inquiry we were told at the Ukraine Academy of Agricultural Sciences that they had several varieties of spherical wheat, Triticum sphericoccum. These varieties are apparently not grown to any extent because of low yields. The seeds are available in the collection at Leningrad at the All-Union Institute of Plant Industry.

Grain Storage.--At the Ministry of Grain Products, Moscow, it was stated that most grain is stored in elevators rather than on the farm and that elevators are located all over the U.S.S.R. in both cities and rural areas. Fumigation is practiced for insect control. Drying was said to be used with an initial hot air temperature of 120° to 140° C. The grain was said to be dried to 14 to 15 percent moisture for storage.

In Omsk somewhat contradictory information was obtained about the moisture content of stored grain. At the agronomic chemistry laboratory of the Siberian Research Institute of Agriculture grain was said to be received at moisture contents as high as 20 percent and dried to 14 percent or less for elevator storage. However, we visited a large grain elevator in Omsk where we were told that the grain was dried to 16±2 percent. Drying facilities were not shown to us. There was said to be as much as 2-percent moisture variation within a bin and the grain is turned every 5 days to avoid heating. When grain reaches 25° to 27° C., it is turned.

At the Omsk grain elevator located on the Irtysh River the total capacity is 160,000 tons. The unloading dock can handle 250 cars in 24 hours; about 6 minutes per car is required. The bucket capacity is 350 tons per hour per bucket, and there are 5 such installations. A total of 315 bins in 3 sections--159 round bins and 156 in-between spaces--are used at Omsk. The round bins each have a capacity of 800 tons. The elevator was clean. It was equipped with a central control room for indicating temperature of grain in the bins and for following and controlling the various operations. Cleaning by aspiration and sieves, distribution by conveyors, and weighing operations are at the stage of mechanization needed and expected in a large elevator of this type. Only small grains were stored at this elevator, much of which comes in by barge.

Industrial Use of Straw.--At the All-Union Mironovskaya Experiment Station, Kiev, it was stated that straw is used as the raw material for making container board in several plants in the Ukraine. This processing is under the Ministry of Light Industry. Usage is neither increasing nor declining. Straw for shipment to the paper mill is baled and shipped as far as 200 to 300 km. to the plant where used. Neither here nor elsewhere could statistics be cited on the amount of straw used for pulping. Straw stacks seen that were said to be for technical use were about 15 feet high, 25 feet wide, and 50 to 100 feet long. Straw is not returned to the soil. At one point in our trip (by motor car from Krasnodar to Piatigorsk), we saw winter wheat straw being burned.

No other annual crops or crop residues other than cereal straws are used for paper to any considerable extent.

Rye

Next to wheat, rye is the most important of the cereal grains grown in the U.S.S.R.

523800 O - 59 - 2

According to their 1956 statistics, it is grown on 14.4 percent of their total grain crop area, or approximately 46 million acres. Unfortunately, much of the rye grown in the area we observed had already been harvested at the time of our arrival. However, several of their so-called new, improved varieties were on display in 10-foot rows at the Moscow Exposition. The stands were good and the varieties apparently pure, but all leaves had dried up as a result of 50 to 100 percent leaf rust infection. Similar percentages of infection were recorded in the three fields observed on collective farms. It was estimated that varietal mixtures amounted to about 25 percent in the three commercial plantings. We were told that ergot is still a problem in some areas, but stem rust has not been a limiting factor in production.

Oats

According to the 1956 Soviet statistics, oats are grown on 37,530,000 acres, or 11.7 percent of the total area in grain crops. With increased emphasis now placed on improvement and increased acreage of corn, it appears likely that oat acreages will correspondingly decrease. Oats in the U.S.S.R. are used primarily as a feed crop, with insignificant amounts for human consumption. We were informed at the All-Union Institute of Plant Industry at Leningrad that N. I. Vavilov's world collection of 8,000 oats was intact and that the seed was grown every 4 or 5 years to maintain viability. We have the general impression that at present relatively little effort is being expended on the improvement of oats and that the varieties now grown meet their requirements except for resistance to crown rust and smut. M. S. Dunin of the Timiryazev Agricultural Academy stated that most of their varieties are susceptible to one or more races of crown rust and that occasionally losses are considerable, particularly in the Ukraine.

We were informed that there are now about 100 commercial varieties of oats grown in the U.S.S.R.; of these, Golden Rain, Victory, Soviet, Shatilov, Orel, Moscow, and Aunea were the varieties commonly grown in the Omsk area. Undoubtedly, Victoria had been used as a parent in some crosses, as many were observed with the typical type 2 reaction to crown rust.

At the present time there appears to be little or no interest in breeding for stem rust resistance, which occasionally causes some loss in local areas. For example, an average of 40-percent rust on all culms was observed in one late-planted field of oats in southwestern Siberia. Oat smuts were observed in many fields and bacterial blight was prevalent in some.

Barley

Barley is grown on approximately 9 percent of the total cereal grain acreage and for the most part the crop is spring-sown. Some winter types are grown in the Crimea where winters are somewhat milder. Two-row types predominated and appeared to be reasonably pure. In the U.S.S.R. barley is used primarily as a feed crop; 75 percent is fed to animals, 15 percent is used for malt, and 10 percent is consumed as food. Diseases on barley appeared to be the same as ours in the United States. Leaf rust, ranging from 5 to 75 percent infection, was observed in all fields, and stem rust infection was light except for one late field near Omsk, where the rust would completely destroy the crop. Loose smut was evident in many fields--from a trace to 3 percent severity--and spot blotch infection was light, causing little or no damage in the 1958 season.

We were informed that Vavilov's world collection of barley is likewise intact at Leningrad and that the viability has been maintained. Vavilov had a sound research program on breeding and genetics of barley under way, but it appears that this has not been continued on an adequate scale. Some selection and a very limited amount of breeding work is conducted in local areas. The best research on development of new barley varieties observed was at the Omsk Experiment Station, where Pallidum and several varieties assigned Omsk numbers were developed and selected for resistance to lodging and shattering and to the Helminthosporium diseases--spot blotch and stripe. Barley at this station had a light infection of the so-called pupation disease caused by a virus, and the workers reported that resistant varieties are now available.

Corn

In 1956 the total area in maize production in the Soviet Union was 59.1 million acres.

BN 8592

Wheat combine with straw catcher operating on a collective farm near Kiev in the Ukraine.

BN 8591

Women cleaning wheat seed on farm in the Ukraine.

BN 8597

Grain terminal building at Omsk, with capacity of 160,000 tons.

BN 8593

Inbred lines of corn at plant breeding station near Alma-Ata, Kazakstan.

Of these, 23.25 million were grown for grain. It was estimated by the Ministry of Grain Products that hybrid seed was used on 80 percent of the acreage planted for grain whereas hybrids were grown on 60 percent of the acreage used for fodder.

Cultural Studies.--Cultural studies with corn were observed at the All-Union Mironovskaya Experiment Station near Kiev, at the Sinelnekova Experiment Station near Dnepropetrovsk, at the State Farm Dekabrist, and at the Alma-Ata Plant Breeding Station.

At Kiev, three experiments were examined in detail. One on methods of ground preparation showed no marked differences among treatments. A second experiment involved kinds, amounts, and placements of fertilizers. High amounts of fertilizers are detrimental when planted with the seed. The most favorable placement is 5 cm. below and 3 cm. to the side of the seed. In a third experiment seed was planted at 10-day intervals from April 20 through May 30, and at 4-, 8-, and 12-cm. depths. The conclusion was that when soil temperature reaches 10° C. at the depth at which corn is to be planted it is time to plant. All experiments were well conceived and conducted in randomized, replicated plots.

At Dnepropetrovsk, extensive studies on time of planting single-cross hybrids and varieties were observed. The purpose was to provide methods of synchronizing pollen and silk emergence in producing hybrid corn.

At the State Farm Dekabrist, a curious field experiment on "half fallow" was being conducted. Fodder corn was planted on fallow land in hills spaced 2 by 2 meters to conserve moisture and still give some fodder production.

The experiments at Alma-Ata were irrigated. Randomized, replicated tests involving time of planting; rates, kind, and time of fertilizer application; and frequency of irrigation were being conducted. In general, the agronomic experiments appear to be similar to those in the United States and designed to answer the particular problems in the Soviet Union.

Corn Breeding.--Corn breeding plots were observed at a number of institutes. At the All-Union Mironovskaya Experiment Station near Kiev, variety tests in randomized experiments with 4 replications of 4-row plots were typical of those observed at all institutes. Several intervariety hybrids were under test. Inbred lines were being developed, but the scope of operations appeared quite small and some outcrosses were observed in lines that were otherwise quite uniform. The hybrid corn work is centered at the All-Union Institute of Corn Research near Dnepropetrovsk and is under the direction of B. P. Sokolov. Single crosses are produced here that are sent to state farms, which in turn produce the double-cross hybrids for delivery to collective farms. At the Krasnodar Research Institute of Agriculture, cytoplasmic male sterility is being incorporated into inbred lines. The Texas and Moldavian sources are being used. In addition, some of the male sterile lines are being converted to pollen-restoring equivalents. This work appears to be capably handled.

At a plant breeding station near Alma-Ata, a collection of inbred lines from northern United States and Canada was observed. Present sources of hybrids in the Soviet Union appear to stem from these inbreds. Hybrids from local sources are principally intervarietal crosses, as inbreeding of locally adapted strains has been done only since 1954.

At Omsk, inbreeding plots with extremely early varieties were observed.

In general, although the work with hybrid corn is of recent origin, the personnel are capable and rapid progress has been made. The main difficulties in the development of corn programs in the Soviet Union appear to be short growing seasons and drought. Disease appears not to be a major factor. Some smut was observed and, near Krasnodar, a few lesions of what appeared to be Helminthosporium. We observed the cornfields at too early a stage to assess the importance of smut or Helminthosporium.

Breeding for Insect Resistance

The importance of breeding for resistance to insect pests was generally recognized, with emphasis on the so-called Swedish, or Oceanella, frit fly and the hessian fly. At the Moscow Agricultural and Industrial Exhibition, damage from the frit fly was

most evident on oats, which developed symptoms similar to red leaf in the United States. The workers reported some losses from this fly on wheat and barley and some progress made in the development of resistant lines in all three crops. Infestation of wheat by Hadena sordida is causing some concern, but no estimates could be obtained as to the extent of losses caused by this insect. The Oceanella frit fly occurs in the United States and Canada, but the Hadena sordida has not been identified in North America.

FORAGE AND FODDER

We were informed that good systems of crop rotation have been worked out for the regions of light and heavy rainfall. Whether or not the prescribed rotations are generally followed could not be determined, but it was evident that the officials of the collective and state farms were well aware of the importance of crop rotation. A typical so-called forage and fodder rotation practiced on State Farm Dekabrist at Ershovsk near Saratov is as follows: (1) Winter rye mixed with crested wheatgrass; (2), (3), and (4) crested wheatgrass; (5) spring wheat on one-half the field and fodder pumpkins, watermelons, and eggplant on the remaining one-half; (6) corn; (7) sudangrass; and (8) annual grasses and millet.

Excellent stands of red clover, yellow lupines, and proso millet were the rule and while some stands of alfalfa were good, a few showed obvious damage from reported winterkilling. Corn, millet, green oats, and barley were being harvested for fodder and carried directly to the barns and feed lots. Later these crops would be used for silage stored in pits or between ricks of hay. Upright silos were not considered necessary. It is reported that "the experience of the last few years showed that maize has been and remains the decisive crop for increasing fodder supply. The battle for increased milk and meat yields is primarily a battle for higher maize yields." Sown grass for hay and green fodder is reported to be grown on 82.75 million acres. No experiments were observed on grass improvement; however, it was reported that considerable progress has been made to improve grasses for drought and hardiness. Fodder production figures up to 1956 are shown in table 3.

TABLE 3.--Fodder production in the U.S.S.R., for selected years[1]

Item	1928	1940	1953	1956	
				Maize	Total
Area under fodder crops (million acres):					
Barley, oats, and maize	72.25	87.75	71.00	23.25	90.75
Root crops and fodder melon crops	.75	2.50	4.25	---	3.75
Silage crops	0	2.00	5.75	15.00	17.75
Sown grass for hay and green fodder	9.00	40.75	61.75	21.50	82.75
Mown natural forage	127.75	148.00	169.00	---	142.25
Silage stocks in collective farms (million tons)	0	40.00	69.25	97.75	157.25

[1] Source: Forty Years of Soviet Power in Facts and Figures. Moscow. 1958.

SUGAR BEETS

Sugar beet is the only source of sugar in the Soviet Union. According to the 1956 statistics the total area in the crop is 5,022,500 acres, an increase of 3,097,500 acres since 1928. Seventy percent of the total production of sugar beets is in the Ukraine. It is our opinion that the culture and research on sugar beets in the U.S.S.R. is good. Their methods of planting and recommended fertilizer application are essentially the same as ours. Figures on yields per acre supplied by several investigators and chairmen of the collectives ranged from 16 to 21 tons per acre in the Ukraine, and at the All-Union Mironovskaya Experiment Station near Kiev they reported the average percentage of sugar to be 16 to 17 and occasionally as high as 22. In some areas beets were kept in storage 200 days prior to processing.

Cercospora leaf spot, black rot, and mildew are the most destructive diseases. However, in the fields observed, only traces of Cercospora were evident and we saw no infection with mildew and black rot. They reported that none of their commercial varieties grown in northern Caucasus are resistant to cercospora leaf spot but that a few new hybrids have been selected in progeny of wide crosses that have a high degree of resistance and high sugar content. Some of their monogerm beets were said to have a higher degree of resistance to the leaf spot than multigerm varieties.

Under the Soviet new plan they hope to have 1,250,000 acres of monogerm beets by 1960. The concept of the development of monogerm lines originated in Russia. Parallel work of this kind with different material has resulted in the development of commercial lines in the United States. The Russians apparently have done little or no inbreeding of sugar beets.

WEEDS

Weeds constitute a major problem, especially in small-grains throughout the U.S.S.R. Three species predominated in the area observed--bindweed, sowthistle, and dock. Some research is being done on the development of herbicides; it would appear that greatest immediate progress could be made in control if greater quantities of herbicides were made available. It was reported that they produced only 5,000 tons of 2,4-D in 1958 which, at our rate of application would be sufficient to treat only 10 to 12 million acres. When applied, excellent results in controlling all three weeds are obtained with 2,4-D. Bindweed was particularly abundant on the new-lands area at Ershovsk near Saratov. No herbicides other than 2,4-D appeared to be in use.

Enroute from Krasnodar to Piatigorsk a truckload of wheat was examined and counts made on prevalence of weed seed. The counts averaged 21 weed seeds per hundred of wheat, which is indicative of the infestation in some areas. Orobanche is reported to be destructive on such crops as hemp and sunflower, and some progress has been made in the development of resistant lines.

HORTICULTURAL CROPS

The Soviet Union is seriously short of fruit. Agricultural Ministry representatives advised us that total fruit production is about 20 pounds per capita, as contrasted to about 150 pounds in the United States. The Soviet figures apparently include fruits used for wine, while the U. S. figures do not. Thus the quantity of fruits per capita available for consumption, either fresh or processed, in the Soviet Union probably is less than 10 percent of that available in the United States. Consequently, fruits are very expensive. We were advised that apples were sold by collective farms to the Government at 4 rubles per kilo, or approximately 18 cents per pound, with the Government furnishing crates.

It is the agricultural policy of the Soviet Union to increase fruit production. Collective farms in all Republics appear to be expanding fruit plantings. Substantial acreages of young orchards and vineyards were observed in all areas visited, and particularly in the areas around Kiev, Krasnodar, Tashkent, and Alma-Ata. Even in interior areas, as Saratov and Omsk in southwestern Siberia, there were substantial plantings, particularly of apples and crabapples. It appears to be the policy to try to produce fruits in all parts of the

BN-8699X

An orchard near Krasnador, showing effects of insufficient moisture and damage from bordeaux spray.

BN-8596

Field of proso millet on a collective farm in the Stavropol area.

BN-8594

Apple "trees" trained for prostrate growth at Moscow Exposition. Trees trained this way are reported to survive extremes of winter temperature better than upright types.

BN-8698X

A large fruit-tree nursery on a collective farm near Krasnador.

U.S.S.R. regardless of how unfavorable for fruit growing climatic conditions may be.

Few parts of the U.S.S.R. are well adapted for fruit production. The best area is said to be the Crimea (not visited), a peninsula in the Black Sea at about 45° north latitude, or the latitude of Salem, Oreg., and Nova Scotia. Because of the tempering influence of the sea, most Temperate Zone fruits, including peaches, apricots, and vinifera grapes are grown. Other favorable locations are south of the Caucasian Mountains in Georgia and Azerbaijan between the Black and Caspian Seas, and in Turkmen S. S.R. and Tadzhik S.S.R., east of the Caspian. In those areas, Soviet territory extends south to about latitude 38° or the latitude of Sacramento, Calif., and Washington, D. C. In addition to fruits, cotton, tea, and mulberry for silkworm feeding are major crops. Only Tashkent, at the northern edge of Tadzhik, was visited.

In Georgia S.S.R., about 80,000 mandarin-type orange trees are grown. The trees are set down in deep trenches so that they can be covered in winter. Ministry representatives termed the method noncommercial.

These most southern areas in the Soviet Union and Crimea appear to be the only ones well adapted to the culture of most Temperate Zone fruits. Grapes, all types of stone fruits, pears, apples, and even figs and olives can be grown. Walnuts, filberts, and almonds are also grown to a limited extent, and pistache nuts are native. A few seedling pecan trees at Tashkent were bearing a fairly good crop. They appeared to be seedlings of Stuart.

In all other areas of the Soviet Union, periods of extreme cold that occur occasionally have been disastrous to tree fruits; few trees over 15 years of age were seen. For example, at Tashkent, temperatures down to -30° C. (-24.4°F.) in November 1955 killed all apples except Yellow Transparent. At Alma-Ata (meaning father of apples) temperatures reached -51°C. (-60° F.) in February 1951 and killed or badly injured most apple trees. Nevertheless, large acreages of young trees have been planted, not only at Alma-Ata but throughout the southern half of the Soviet Union.

Even in Siberia, near Omsk, 10,000 to 12,000 acres of apples have been planted and are being trained by keeping them "pegged down" to the ground. In this system, the tree is planted with the trunk at about a 30° angle with the soil. All branches that are retained are fastened down to the ground with wire hooks driven into the soil. Trees so trained are said to tolerate cold far better than trees with trunks even when there is no snow or other cover. Also, such trees come into bearing early. No sun burning of fruit on such trees was observed, probably because summer temperatures are moderate in the areas where the system is used. Much hand work is required to keep the soil free of weeds under and among such trees and to peg down the branches. Quality of fruit would generally not be high. Color development would generally be poor. However, yields seemed quite good in 1958. Such trees receive no artificial cover in winter and snowfall in Siberia is generally limited. In that area only Siberian crab was being grown as "trees" with trunks.

In the more northern latitude of European U.S.S.R., black and red currants and gooseberries are grown extensively and appear completely hardy. Yields of 10 tons per acre are reported. Strawberries are grown at Moscow without artificial cover, but snow cover is quite dependable there. Sour cherries and the "Mitchurin" apples, selected by the horticulturist Mitchurin for extreme hardiness, are grown to a limited extent. A native cranberry is harvested in quantity from the wild, as is also the native amelanchier, or serviceberry.

In the vicinity of Kiev in the Ukraine, 50° N., or the same as Winnipeg, Canada, but with milder climate, apples, pears, plums, sour cherries, strawberries, and red raspberries are grown, as well as gooseberries and currants. One collective farm visited had about 675 acres in fruits, including 80 acres of vinifera grapes, trained to cover the plants with soil in winter. We were told that fruit is being planted extensively in the more southern parts of Ukraine S.S.R., particularly near Odessa and in the Crimea. Similar extensive planting is going on around Krasnodar, east of the Black Sea. The goal for this Kuban' area is to increase grape plantings 15-fold by 1965 despite necessity of covering vines in winter.

Rootstocks

All grapes in the Soviet Union are propagated on their own roots. Phylloxera is

said not to be present and every effort is being made to prevent introduction. Apples are largely grown on "wild apple" stocks, seed for which is collected in the mountains. However, at the Northern Caucasian Institute for Horticultural Crops and Grape Growing, Krasnodar, it was stated that some varieties make poor unions with wild apple and that brown spots develop in roots and the seedlings die in about 2 years. This suggests the possibility of a virus in some apple varieties that is lethal to the native apple rootstock. Seed of early commercial apple varieties is now being used for stocks in that area.

Prunus mahaleb, the wild cherry of the area, is largely used as the stock for both sour and sweet cherries in the northern Kuban' area, as it is hardy and drought resistant. In the southern Kuban', wild sweet cherry is used as the stock for sweet varieties. Pears are all propagated on Prunus divaricata, native in the mountains. Most peaches are on peach, and apricots are on apricot roots.

Pruning and Training of Fruits

In all areas except parts of Georgia S.S.R., vinifera grapes must be covered for protection in winter. In one system, trunks are "headed" just above the soil surface. Fruiting laterals from these trunks are tied up to 2-wire trellises as they grow each season. A second system is to build semicircular arbors of willow poles, about 8 feet high. The trunks of the grapes are tied up to these trellises each spring and are laid down on the ground in the fall. In both systems, soil is plowed over the trunks for winter protection.

Apples and other tree fruits, except where pegged to the soil in the most severe climatic areas, are rather high headed, usually about 30 inches to the first branch. A number of side branches develop close together on the trunk, giving "bunchy" type trees. The recommendation by Russian horticulturists was to prune trees heavily until they come into bearing, then prune lightly. The practice delays fruiting and generally results in poorly shaped trees. Current tree pruning and training practices in the U.S.S.R. are much like those recommended in the U.S. 45 years ago. Research in the United States showed fruiting to be delayed and weak crotch development to result from the practice and it has been discontinued. Now minimum pruning up to bearing age is the general practice in the United States. We believe careful research in the U.S.S.R. would show the practices being recommended there to be undesirable.

Pest control

Bordeaux mixture is the fungicide generally used on fruit crops. In most apple orchards visited bordeaux had been used. Widespread injury to the foliage and considerable fruit russet was the result. Organic fungicides now widely used in western countries appear not available in the U.S.S.R. Ministry officials stated they are trying to make captan but "are having trouble with its formulation."

DDT is generally used for coddling moth control of apples and pears. In some orchards there was considerable worm injury, possibly because of poor timing or inadequate coverage by the insecticide. In some orchards there were severe mite infestations.

Moisture supply

In nearly all areas visited, moisture supply is a limiting factor in fruit growing, particularly for the tree fruits. Most areas where fruits are grown have less than 20 inches precipitation. All orchards are clean cultivated to conserve moisture. Despite this, most of the fruit was small and older trees appeared unthrifty, primarily because of limited moisture. In the few irrigated orchards visited, tree growth and fruit size were much better. It was evident that irrigation is needed in all the areas best adapted for fruit production. Water for irrigation is not available over much of these areas, unless it can be obtained from wells. To date there has been little if any well irrigation developed in the Soviet Union.

Fruit research

A rather large number of stations devoted to fruit research are maintained, especially in the southern Ukraine, in Kuban', and in other southern areas. These seem to be concerned largely with variety evaluation and some breeding. We were advised that in Kuban , 450 grape varieties, 350 apricot,

240 peach, 500 apple, 256 pear, 206 sweet cherry, and 75 strawberry varieties were being tested. Twenty-four thousand plants were in breeding plots, and 175 new fruit varieties have been introduced in recent years.

We did not see experimental work on pest control, on soil management and fertilization, on pruning or training, on rootstocks or fruit thinning. Possibly some such work was under way at stations not visited. In the areas visited, hardiness in varieties to survive the extremes of low temperatures appeared by far the most critical problem and the one on which most effort is concentrated.

General Conclusions

The extreme hazard from low temperatures and moisture shortage will limit production of tree fruits in most parts of the Soviet Union. As improved transportation and storage facilities are developed, fruit centers should be largely located in the Crimea and other areas protected by the Black and Caspian Seas and on favorable sites in the southernmost parts of Kuban and Uzbekistan. All of these most desirable locations will require irrigation for efficient production of high-quality fruit. Extensive processing facilities will be needed. At present apparently little fruit is canned or processed, except to make wine. Better pesticide chemicals, particularly fungicides and miticides, are needed. The very extensive planting programs now under way in areas poorly adapted for fruit growing are likely to be disappointing. Some such plantings are profitable at present because of the very high prices being paid for fruit of mediocre quality. These prices largely eliminate the use of fruit by the great mass of the population.

VEGETABLES

The most important vegetable crops in the Soviet Union appeared to be potatoes and other root crops--especially onions, carrots, and beets--and cabbage, peas, tomatoes, and cucumbers. Beans, both dried and snap, were conspicuously absent. We were informed that Soviet people were largely unfamiliar with beans, therefore they are not grown. The country would appear well adapted for bean growing. Also, apparently leafy vegetables such as lettuce and spinach are little grown. Cucumbers are greatly prized, and during the summer this vegetable is consumed in great quantities, both fresh and brined. Sweet corn is said to be grown and eaten, but we saw none in the fields or being served. Melons are extensively grown and used in the southern areas. We were advised that 200 kinds of melons are grown in the Tashkent area, some of which can be stored until April or May. Squash and pumpkins are also rather widely grown.

Potatoes are by far the most important vegetable. Considerable acreages were being grown on nearly all farms visited. Fields were generally severely infected with viruses and in some, 70 percent or more of the plants were infected. Growers state they obtain "elite" or new seed stock about once in 4 years. The other years they plant their own seed. "Elite" seed is grown on farms in the same general area. On one farm visited that was producing "elite" seed, we found what appeared to be ordinary stock. Virus-infected or offtype plants in this field were being rogued, and by early August, nearly half of the plants had been pulled. The residue at the end of the season would be dug as "elite" seed. Obviously such seed would carry much virus and would be only a moderate improvement over ordinary farmer stocks. There is outstanding need for the development of a sound potato-seed program.

Tomatoes are field grown only in the southern one-half to one-third of the Soviet Union. In other areas the growing season is too short and too cool to mature the fruit. In the areas visited, determinate-type varieties were mainly grown. Fruit was ripening in southern areas. It was mostly medium- to small-sized fruit and usually of good quality. Yields were reported as generally about 15 tons per acre. No conspicuous diseases were observed. Some processing of tomatoes is done, and tomato juice of fairly good quality was obtainable in most hotels. At Krasnodar local tomatoes were selling on the free farm market at 2 to 3 rubles per kilo or around 10 cents per pound.

One greenhouse, producing mostly tomatoes and cucumbers, was visited at Omsk in southwestern Siberia. About 125,000

square feet were under glass, heated mainly with hot water piped from a coal power plant. Yields were reported at about 2 pounds per square foot for tomatoes, 2.5 pounds for cucumbers. Nonheated "solar" greenhouses are also used in the area. They are constructed mostly below ground level with glass 2 to 3 feet aboveground. Tomatoes in these ripen 1 to 2 months earlier than in the open.

Some tomatoes were being grown in open fields near Omsk. Fruit was about half grown on August 10. Few fruit would mature if an early frost occurred, but some would ripen before September 1.

Considerable acreages of carrots, onions, table beets, cabbage, and pumpkins and squash were grown on many of the collective farms visited. Many had belowground storages in which such crops could be held for winter and spring use. No important diseases or insect infestations were observed on these crops.

An appreciable amount of canning of tomatoes and tomato juice and peas is apparently done. Sweet corn is not canned. There appeared to be rather large production of a few major vegetable crops. We saw no asparagus, little rhubarb, no sprouting broccoli, no cauliflower, no lettuce or spinach. Ministry officials advised that they have as an objective increasing the number of vegetable crops through introducing and publicizing kinds not now generally grown or known.

Vegetable seed is produced in all Republics where the vegetables are grown. No specialized vegetable-seed-growing areas have been developed. This is also true for potato-seed stock.

OIL CROPS

Sunflower

The sunflower is the most important oilseed crop in the U.S.S.R. Crop estimates for 1958 indicate an area of about 10 million acres. Information obtained in Moscow gave the following percentage of oil crop area planted: Sunflower, 70; flax, 9.3; soybean, 7.9; mustard, 5.4; rape, 4.6; and all others, 1.9.

The general concensus of our survey group was that the breeding program with sunflower in the U.S.S.R. has been excellent. Its leadership has been, for many years, in the hands of V. C. Pustovoit at the All-Union Institute of Oil-Bearing Crops in Krasnodar. During the period 1913-57 breeding research on sunflower has resulted in reduction of hull from 43 or 44 percent to 23 to 25 percent, while the oil content has been increased from 28 to 33 percent to 43 to 46 percent. One particular line still in the experimental stage was said to yield as high as 60 percent oil, and a few others have as high as 52 percent. Yields of seed were said to be as high as a ton per acre or more.

Ninety percent of sunflower oil is expressed by pressing, 10 percent by extraction. Oil recovery on processing was said to be 96 percent. Substantially all the sunflower oil is for food purposes. Other detailed oil figures are cited in table 4.

TABLE 4.--Amount of oil in sunflower seed at harvest and amount extracted, U.S.S.R., selected years

Year	Oil in commercial sunflower seed	Oil extracted from seed in factories
	Percent	*Percent*
1940	29.4	26.2
1955	38.8	37.0
1956	39.2	37.5
1957	40.9	39.3

The chief area of sunflower production is in the northern Caucasus region, the Ukraine black soil region, and around the Volga River Basin. Extensive plantings were seen, however, in some places as far north as Siberia and eastward in Kazakh S.S.R.

Rust has been an important deterring disease in the production of sunflower seed in Russia as well as elsewhere. It was claimed that the better U.S.S.R. varieties are now resistant to rust, and our observations bear this out, as we saw no rust in any of the fields we surveyed. Another bad pest of sunflower, as well as other crops in southern Russia, has been the parasitic weed Orobanche. It was reported that the better varieties now have resistance to this also. Experimental lines have recently been developed that have resistance to downy mildew, but none of these sunflowers is yet in commercial production. Much of the disease resistence has been obtained through interspecific crosses, largely with Helianthus tuberosus.

Most commercial varieties seen on collective farms were tall-plant types, 6 feet or more. In experimental fields, however, were some dwarf and very uniform lines. It was said that sunflower as a crop was now completely mechanized from planting to harvest. None of the fields had reached the harvest stage, and we had no opportunity to observe harvest machinery.

Castorbeans

Castorbeans was said to be grown on 27,500 acres, of which about 22,000 acres are in the Kuban' River area. The average seed-oil content is 48 to 53 percent. The U.S.S.R. proposes a 20-fold expansion of this crop in the next 2 years based on the development of a new variety, Krasnodar No. 165. This variety has a determinate inflorescence and the property of leaf-abscission at maturity. It is said to be nonshattering as to seed. Planting and cultivation are mechanized. Mechanized harvesting is still a problem, as it is in the United States.

Perilla

Perilla was once grown rather widely (42,000 acres in 1938). In 1958 it was said to be grown on no more than 500 acres and that acreage was in the Far East. Reasons given were high cost of production, no means for mechanized harvesting, and excessive damage by dry winds.

Flax

Flax acreage has increased from 885,000 acres in 1940 to 1,135,000 acres in 1957. Average oil content of the seed is 40 to 46 percent. As an example of yield, 100 acres of flax grown on a collective farm in the Stavropol region was said to give 700 to 1,050 pounds of seed per acre. Unfortunately, rather few fields of flax were observed in the area traveled. We were informed, however, that considerably greater emphasis is placed on fiber flax than on flax for oil. Apparently some effort is being made to improve and develop dual-purpose varieties. It was stated that they have problems with wilt, rust, and pasmo diseases with all types.

Sesame

Sesame is receiving some experimental attention at the All-Union Institute of Oil-Bearing Crops in Krasnodar. Two varieties have been developed at the institute that have resistance to bacterial wilt and to the parasitic weed Orobanche. All varieties shatter their seed. One variety, Kubanitz, was reported having 55 percent oil. In Central Asia about 50,000 acres of sesame are raised, the oil all going for food use.

Safflower

Safflower is grown in the U.S.S.R. on about 72,000 acres. About 47,000 acres are grown in Kazakh S.S.R. and the remaining 25,000 acres in Uzbek S.S.R. A small acreage was reported of a thornless safflower type that is grown both for fodder and oil. Seed yield of the thornless variety was reported as 350 to 450 pounds per acre.

Soybeans

Soybean production has largely shifted to the Far East where about 970,000 acres were grown in 1957. No soybeans were seen in production anywhere on our itinerary.

Mustard

Two types of mustard were said to be grown, both for food purposes. Yields average 900 to 1,050 pounds per acre. Gray mustard averages 35 to 39 percent oil in the seed, and white mustard, 27 to 36 percent. There was said to be no difference in the oil. It was reported that 560,000 acres

of rape are grown chiefly in the Urals and adjacent Siberia. The oil averages 38 to 42 percent.

False flax

At the Research Institute of Agriculture for the Southeastern Area (Saratov) it was said that approximately 50,000 acres of false flax, Camelina sativa, are grown for its seed-oil in areas too dry for sunflower production. Camelina was said to be relatively free of insect pests, and yields of about 1,000 pounds per acre were obtained.

Peanuts

In Krasnodar at the All-Union Institute for Oil-Bearing Crops it was reported that there is practically no production of peanuts in the U.S.S.R. Some experimental work in breeding and selection is going forward in fields of the institute. The objectives are earliness and large-seeded oil-producing types. The institute has types that can be harvested in the Krasnodar area by September 28 and these types will average 54 percent oil. An experimental field of about 20 acres was observed in flower on July 27. The plants were about 12 inches high and planted about 7 plants to the hill. This variety was a small-seeded Spanish type with 3 seeds to the pod.

Essential oils

From information obtained at various places it appears that investigations are under way on about 30 essential oil plants. Most of the production is in the Ukraine. Between 7,000 and 10,000 acres of Mentha were reported under cultivation. Experimental plots at Krasnodar were not impressive, probably due to lack of moisture. Two varieties of Mentha were under trial. Reported yields were 1.2 tons of dry leaves and flowers per acre and 52 pounds of oil per acre.

TOBACCO

At the All-Union Institute of Tobacco at Krasnodar it was reported that about 250,000 acres of Nicotiana tabacum and 200,000 acres of Nicotiana rustica were grown in the U.S.S.R. N. tabacum is grown mainly in the Caucasus region, Georgia, Azerbaijan, Armenia, and Central Asia. N. rustica is grown to the north or near the latitude of Moscow. It is grown because some smokers like it better than N. tabacum, but 15 to 20 percent is used for industrial purposes. There is 10 to 12 percent citric acid in the leaves--more than in a lemon. Nicotine and citric acid both can be extracted in the same process. The production of citric acid from tobacco is not now considered so important as previously.

An interesting line of investigation being carried forward is on artificial fermentation processing of tobacco. Seasonal natural curing and fermentation takes about 3 months. Techniques being developed at the institute would shorten the time considerably and make the process independent of seasonal demands.

The institute maintains a large germplasm collection of world tobacco varieties and species from which breeders may draw as needed.

The principal diseases affecting tobacco are black root rot, gray stem rot, and various leaf spots. Workers at the institute state they have no nematode problems. The institute has developed broadleaf types resistant to mildew and mosaic, similar to American types and locally adapted. Breeding methods used were interspecies crosses. The mosaic resistance was obtained from an amphidiploid of the interspecies cross N. glutinosa x N. sylvestris.

Cigarette smoking appeared the main use of tobacco in the U.S.S.R. Practically no cigar or pipe smoking and no chewing of tobacco were seen. Cigarette smoking, however, was widespread.

FIBER CROPS

Hemp

At the Krasnodar Research Institute of Agriculture considerable attention is given to hemp breeding. The total area of hemp grown in the U.S.S.R. is $1\frac{1}{2}$ million acres. The Krasnodar area is not ideal for hemp; the main job is to develop varieties and get seed for production elsewhere. There is 18

percent fiber in the plant, and 15 percent pure fiber can be obtained based on dry stems. Yields of 1,050 pounds of fiber per acre are obtainable, but in Uzbekistan up to double this production can be obtained on irrigated land. At Collective Farm Stalin in the Stavropol region, 500 acres of hemp were said to yield up to 1.75 tons per acre of stems, plus 220 pounds of seed per acre.

The principal problem at present is to develop a good monoecious variety of hemp to avoid the hand labor of harvesting the male plants of dioecious varieties long before the female plants. For example, the male plants mature a month before the female plants. A monoecious variety can be harvested by machine all at once. Several good monoecious varieties have been developed. One of these is Krasnodarsky yushny (85 percent monoecious, not completely homogeneous). The growing season of the monoecious varieties is 130 to 135 days, while that of the dioecious varieties is 140 to 150 days. Although the main product of hemp is fiber, oilseed is also an important product. Yield of oil from seed is 32 to 35 percent. The hemp was said to be low in alkaloid content, but no definite information on alkaloid determination could be obtained. The parasitic weed (Orobanche ramosa) is a serious pest of hemp fields, and successful varieties must have resistance to it. Some progress has been made toward this end.

Kenaf

At the Krasnodar Research Institute of Agriculture we were told that some work had been done on kenaf (Hibiscus cannabinus), but since the crop is largely grown in Uzbekistan, no work is now in progress in Krasnodar. A variety, Kubansky No. 333, was developed that is a highly productive fiber type. In Uzbekistan the yield is usually about 3.3 to 4.4 tons of dry stems per acre. Yields of 1 ton of dry fiber per acre have been obtained. About 90,000 acres of kenaf are grown in the U.S.S.R., half of it in Uzbek S.S.R. Other fiber plants that are being considered, but with no special work in progress, are Abutilon avicennae and kendyr (Apocynum venetum). There is no commercial production. About 7,500 acres of jute are planted in Uzbek S.S.R.

Cotton

Only limited observations were made on cotton research and production, as this was the objective of a special survey team from the United States.

At the All-Union Institute of Plant Chemistry, Tashkent, several interesting lines of research on cotton were discussed. Chemical composition studies are being carried out on each plant part; i.e., leaves, flowers, stems, roots. This is done at different maturity stages (5-day intervals) in an attempt to show how composition changes.

Over 30 compounds have been separated from a petroleum ether extract of cotton leaves. Cotton leaves contain 6 to 7 percent citric acid, and about 5 percent of this amount can be extracted in pure form. This is done commercially to the extent of 5,000 tons per year, and expansion of this production is planned. The leaves also contain 3 to 5 percent malic acid. These acids may be isolated as calcium salts. Cotton flowers contain phytosterols in good quantity. The pods contain pectin and 15 percent of polyphenols, study of the structure of some of which is now in progress.

Cotton stems have no present actual usage, although consideration has been given to utilization in paper or production of furfural, alcohol, etc. after hydrolysis of the stem polysaccharides.

Gossypol is separated from cotton roots and is under study as an anti-oxidant and possible source for synthesizing other useful derivatives.

At the Institute of Cotton Genetics, Tashkent, studies on the physiology and biochemistry of the cotton plant showed that there are demonstrable differences between plants susceptible and resistant to wilt. Healthy non-wilt-resistant cotton plants have lower starch content, higher content of glucosidase enzyme systems, and higher content of phenols. When susceptible plants become infected, the enzyme systems release free phenols and tannins that accumulate and poison the plant, causing wilting. Free phenols introduced into healthy plants cause the same type of damage.

Oil content of cottonseeds of different varieties varies greatly, from 17 to 27

BN-8590

Small-seeded, Spanish-type peanuts grown in experimental fields at the Oil Seeds Institute at Krasnodar.

BN-8595

Field of sunflowers grown near Krasnodar.

BN-8700X

Tobacco lines from worldwide collections at the All Union Institute for Research on Tobacco, Krasnodar.

BN-8701 X

Barnyard manure piled for drying and for use as fuel in the Kuban .

percent. Nitrogen fertilizers reduce oil and increase protein content of the seeds, while phosphorus fertilizers do the reverse. It was stated that potash does not affect oil content (contrary to U.S. experience). No tests of oil quality were made at the plant-growing institutes visited.

At the Ak-Kavakskaia Experimental Station of the Institute of Cotton Genetics, Tashkent, research on fiber development in the immature boll was reported. A short season sometimes prevents normal maturity. It was found that a 17-day old boll containing 5 percent cellulose and 60 percent sugars (dry basis), if incubated at 35° C. for 5 days, can be "artificially matured." The sugars disappear and 60 percent of cellulose is present. Humidity control is unnecessary. Twenty-day old bolls can also be used. Cotton from a 14-day old boll does not produce fiber with normal properties.

GENETICS AND PLANT BREEDING

In 1943, the book entitled, "Heredity and Its Variability," was first published by T. D. Lysenko. This book was translated into English from the Russian by Theodosius Dobshansky and published in 1946. One of the objectives of the crops delegation was to attempt to evaluate the impact of Lysenko's theories on genetic research and his influence on the methods of breeding agricultural crops.

The Institute of Genetics in Moscow, where T. D. Lysenko is Director, was visited on July 18, 1958. The delegation was welcomed by Mr. Lysenko, who informed us that he could spend at most an hour or two with us since his health was not good. However, he accompanied us throughout our entire visit, which lasted until late that evening.

The Institute of Genetics is in the biological department of the All-Union Lenin Academy of Agricultural Sciences. The Institute is divided into five departments or laboratories, as follows:

1. The laboratory of plant genetics under T. D. Lysenko.
2. The laboratory of animal genetics under K. F. Kushner.
3. The laboratory of cytology under N. I. Nuzhdin.
4. The biology laboratory under K. S. Zhukov.
5. The laboratory of micro-organisms under the Deputy Director of the Institute, K. V. Kosikov.

The Institute of Genetics is engaged primarily in the following lines of research:

1. Studies of directed hereditary changes, mostly on plants, but to some extent also on micro-organisms, viruses, and animals.
2. Studies of heterosis and the choice of parents in hybridization.
3. The biology of fertilization in both plants and animals.
4. Cytology and radio-biology.

Professor Lysenko gave us a brief outline of his philosophy of heredity. He stated that pure genetics is only a part of the science of biology as a whole and is not separable from it. He said that he recognized that there were a number of Western geneticists who claimed that he, Lysenko, had thrown aside the laws of genetic inheritances. This was not so. It was only that he disagreed in the mechanism of genetic inheritances. In general, the views that he outlined on heredity do not differ from those presented in his original book. Hence, it is not necessary to present them here. The plant improvement procedures that have resulted from these ideas, however, need to be elucidated.

One of Lysenko's main ideas is that the heredity of an organism is not associated with a specific substance and can be changed in response to external environmental conditions. For example, it is possible to "convert" spring wheat to winter wheat by planting and subjecting spring wheat varieties to more and more rigorous winter conditions until finally a conversion from spring to winter habit is brought about. A corollary of this idea is that selection for improvement of plants from an agronomic standpoint can only be effective under the best cultural conditions.

The "conclusive proof" of this was shown in the field that afternoon. The experiment consisted of planting 5 kilograms of spring wheat in the fall. Seed was harvested and used to plant 2 hectares. Seed from this was used to plant a 20-hectare field that was shown to us. Although, according to Lysenko, the spring wheat

used for this experiment was awned, awnless heads were observed and there were differences in chaff color, pubescence, and other characters.

A suggested method for bringing about fusion of heredities is through the use of "vegetative hybridization." The procedure followed is to graft a scion that is to be changed to a stock whose properties are to be incorporated into the scion. Seed is collected from the scion and is said to give rise to segregation and mixtures of hereditary properties. These mixtures may not appear in the first generation but will appear in the second, third, or fourth generations.

Another idea is that fertilization may involve a fusion of heredities of the female and more than one male gamate when pollen from several male parents is mixed and applied to stigmas. This is the so-called Mitchurin method of plant breeding. In the visits of the delegation to the various plant breeding institutions in the Soviet Union, it was desired to determine the extent of the influence of these ideas on the plant-breeding procedures used.

At the All-Union Sugar Beet Institute near Kiev, we found that vegetative hybridization of table beets and sugar beets was being tried. From this vegetative cross, the workers said that they had obtained beets resistant to root rot in storage. At this institution, however, we found that conventional breeding methods also were being used, primarily mass selection following intervarietal hybridization.

At the All-Union Mironovskaya Experiment Station located about 100 kilometers southeast of Kiev, we were told that a new variety of winter wheat, Mironovskaya 264, was developed by the method of directed changes from the spring wheat variety Narodnaya.

At the Research Institute of Agriculture for the Southeastern Area, near Saratov, we were told that winter wheat had been converted to spring wheat at this station, that some of these varieties looked good, but that none was in commercial production as yet. There is no winter wheat in this area. A variety of mustard was on display. It was said to have been produced by vegetative hybridization, but no details were given. It was said that students regularly produce vegetative hybrids in tomatoes.

At the Uzbek Academy of Agricultural Sciences in Tashkent we were told that vegetative hybrids had been produced by grafting a cotton species Gossypium herbaceum, with a chromosome number of 26, to G. hirsutum, which has a chromosome number of 52. We were told that there are now strains with 39 chromosomes from this cross that are homozygous and which derive their resistance from G. herbaceum. We were given an opportunity to visit a cotton breeding station near Tashkent. At this station we learned that the impressions gained from the Uzbek Academy of Sciences were somewhat erroneous, in that vegetative hybridization is being used but it is employed to study the influence of the stocks of various species on F_1 hybrids grafted to them. Although mixed pollination was being used at the Tashkent station, it was apparent that this mixture of pollen was of some assistance in obtaining wide crosses. A probable hormonal effect was recognized.

At a plant breeding station near Alma-Ata we were shown results from a selection experiment with wheat in which the wheat was grown under progressively improved cultural conditions, accompanied by simultaneous selection for longer grain-head type and higher yield. The illustrations and samples shown indicated that this method was effective, but there were no controlled treatments to indicate whether it was selection or improved cultural conditions that had resulted in the improvement.

Perhaps the most intensive utilization of environmental conversion and vegetative hybridization was found at the Siberian Research Institute of Agriculture near Omsk. Here we saw many varieties of wheat on test that we were told had been converted from winter to spring habit. Vegetative hybridization with sunflowers by means of approach grafting was used, but the grafts were left to open pollinate. This was indicated as the main method of improving the sunflower for this region. We also understood that vegetative hybridization was being practiced in potatoes. A wart-resistant scion was grafted to the stock of a susceptible, highly productive variety, and tubers from the stock were collected as being the vegetative hybrids and resistant to wart. The widespread use of methods advocated by Lysenko at this station are

understandable, as Lysenko spent some years at this particular institute while Russia was at war with Germany.

Despite these evidences of the use of the methods advocated by Lysenko, conventional methods were generally being used in crop improvement, especially at those institutions where plant breeding was a major activity. It is possible that some of these ideas have actually led, in some cases, to greater imagination in physiologic studies. For example, at the Institute of Cotton Genetics near Tashkent, the use of pollen from two or more species on stigmas of a third species provided a quicker method of obtaining interspecific hybrids. At this same institute studies of the influence of stocks of different species on the type of segregation obtained from interspecific hybrids that are grafted to these stocks may extend our concepts of interaction between stock and scion. At the Plant Breeding Station near Alma-Ata, it was found that studies on vernalization of corn before planting had an extreme effect on the type of growth obtained and the period from planting to pollen shedding. This may have practical importance in controlling and facilitating time of pollen shedding in relation to the production of hybrid seed corn. At the Siberian Research Institute of Agriculture in Omsk, control of smut in wheat by late fall planting was practical. Cold-temperature shocks through the winter to control smut may be an important beneficial side effect derived from efforts to convert growth habit in wheat.

Disregarding these evidences of Lysenkoism, it would appear that plant breeding work on most crops in Russia is comparable to that done in the United States.

Crosses between varieties followed by selection is a common method of breeding. "Multi-stages breeding," which involves the crossing of an F_1 between two varieties with a third variety, appears to be a common method of hybridization. Interspecific hybridization is being used extensively. F_1 hybrids between inbred lines or between varieties are used for the commercial crop in corn. Some lines are being converted to cytoplasmic male-sterile equivalents.

Perhaps one of the outstanding achievements in U.S.S.R. is the development of disease-resistant sunflowers with high oil content. The sunflower is the principal oil-producing crop in the Soviet Union. The method indicated was to cross the 34-chromosome common sunflower with a species containing 102 chromosomes. Backcrosses were made to the 34-chromosome type, 34-chromosome plants were recovered, followed by recurrent mass selection. Oil content, uniformity, and disease resistance were improved.

Cytology work, particularly with cotton, tobacco, and wheat, was good, but no basic genetic research was found at any of the plant breeding institutes. The objectives appear to be directed primarily toward the practical end of producing new varieties as rapidly as possible. Individual genes were not being studied. No hint that linkage studies were being made was found in the discussions at any of the institutes. It may be speculated that either there is no work of this type going on or that we did not have an opportunity to visit the institutes where it is being done with agronomically important plants. The first supposition appears to be the more logical, since we probably visited a cross section of the plant breeding and genetic institutes where this type of work should be found if it is being done at all. It may be that it is in this area that the most important negative influence of Lysenko's teaching is being felt. This may also be the reason why single-gene resistance to specific races of disease organisms is being neglected. We believe that one of the weakest phases of their plant breeding research was the lack of supporting pathology work.

In general, there is specific and sufficient sources of good germ plasm in the Soviet Union to make it important that interchange of germ plasm between the Soviet Union and the United States be reestablished and maintained hereafter.

UTILIZATION AND NEW CROPS RESEARCH

In the United States surplus production of certain major crops has led to establishment of a broad scientific program to discover ways for expanding their utilization and, more recently, to investigate the discovery and development of profitable alternative crops. Agricultural utilization research in this country includes the search for new

and improved products and processing methods and for new and increased uses that can be found for commodities under study, employing such chemical, biological, and engineering disciplines and acquiring such basic information as are required to attain the objective.

No parallel centralized or coordinated program of agricultural utilization research of the type and magnitude under way in the U. S. Department of Agriculture appears to be present in the Soviet Union today. Soviet agricultural production is not in excess of the food, feed, and fiber needs of the country. Rather, there are problems of underproduction of some major crops. Thus, there is no need for the development of research programs to find alternate or expanded industrial uses for present agricultural production. For the same reason, there is little concern for the development of entirely new crops. Primary emphasis is on maintaining and increasing agricultural production.

Utilization Research

At each location visited, information was sought on the utilization of agricultural products, including research facilities available and any planned research programs that might be in progress. Utilization research described to us was directed largely toward one of three objectives. (1) Within the Ministry of Agriculture the function of physical science laboratories is almost exclusively to service the agricultural production groups in such problems as quality control, analyses of breeding stocks, and soils and fertilizer chemistry. (2) Investigations on the chemistry of plant and animal products to provide a basis for more complete and efficient utilization are conducted in a few institutes under the All-Union Lenin Academy of Agricultural Sciences and the academies of science of individual Republics. For example, study is being made of use of cotton and tobacco leaves as sources of citric acid, of wild plants for medicinals, and of a number of uncultivated species as sources of industrial oils, essential oils, or resins. (3) Processing research on sugar beets, sunflower seed, cotton, and other technical crops was said to be under local control of the "People's Economy Council" of the district in which each particular processing plant was located. Additional processing research is in other ministries, such as the Ministry of Feed Production, Ministry of Food Production, and Ministry of Light Industry. Opportunity was provided to acquire some information related to the first two areas of utilization research mentioned. For example, experimental facilities for wheat quality evaluation were visited, including an experimental flour mill. Such observations on use aspects of crops following harvest are included in the appropriate sections above devoted to the different commodities.

As the Soviet Ministry of Agriculture was in charge of the agricultural crops delegation, most laboratories visited were those within its jurisdiction. Opportunities were afforded to visit only a few installations of other agencies and to acquire information about broader utilization aspects. Deviations from the preplanned schedule were permitted on only a limited number of occasions. Informal flexible arrangements were difficult to achieve, because of the full and preplanned schedule.

From titles of many of the institutes (e.g., All-Union Research Institute for Oil-Bearing Crops), it might be presumed that scope of investigations is broader than just production aspects. Future visiting delegations or individuals might bear in mind that this is often not the case. Furthermore, scientists interested in crop utilization might preferably visit the Soviet Union later in the year to avoid prevalent July and August absence of chemical personnel and to be able to observe (seasonal) processing operations on technical crops after their harvest. More complete assessment of Russian farm product utilization must await further appraisals of Soviet technical literature and visits of future groups with primary interests in this field and having a scheduled itinerary planned accordingly.

New Crops Research

In the course of the trip special note was taken as to possible new crop material with potential for the United States. Nothing was observed in production or in experimental plots that had not already received some assessment as to value in the United States. Considerable literature has emanated from the U.S.S.R. in past years on the potentials for agricultural development of various economic plants. However, the only location where any serious interest in

new crops was expressed was in Leningrad at the All-Union Institute of Plant Industry and at the Komorov Institute of Botany.

The first of these has also been called the Institute of Plant Growing and formerly the Institute of Applied Botany and New Crops. It was organized in 1924. Some of its functions are analagous to the New Crops Research Branch, Crops Research Division, ARS. Collections are made of native and local flora of the U.S.S.R., and plants are introduced from abroad by collection or exchange. Purposes of the institute, as stated, were (1) theoretical investigation of plants cultivated all over the world; and (2) evaluation and distribution of stocks to institutes and experiment stations. Very large collections of viable seed are maintained to discharge this latter function. (The Institute of Plant Industry works with native plant material from the Botanical Institute, which is also interested in herbarium collections and theoretical and more long-range research on plants.) The Institute of Plant Industry has published extensive series of books and monographs relating to economic plants and plant resources. Breeding and genetics and quality evaluation of plants are also within the scope of the institute. Major emphasis is on new germ plasm and on the discovery and development of completely new crops.

Before the visit to the U.S.S.R. a monograph by Russian Professors Ilin and Sharapov on New Fatty Oil Plants had been obtained and translated. At Leningrad, Sharapov, who had actually done this work, was on vacation, but we had an opportunity to talk with Ilin at the Komorov Institute of Botany. Professor Ilin heads the Plant Resources studies of useful and economic plants of this Institute. Apparently there is no further information available in addition to that published, either by way of inclusion of additional species or of more detailed chemical composition studies on the oilseeds listed in the monograph. Other than percentage of total oil and analytical constants such as iodine value, saponification value, and refractive index, nothing is known about the oils.

The Komorov Institute of Botany was originally organized in 1714 as a drug garden; its present organization was established in 1931. One of the best equipped laboratories for organic chemical work encountered during our tour was at this botanical institute. They have, for example, infrared and ultraviolet spectrophotometers, a microanalytical laboratory, an ozonizer, and a variety of other facilities needed for chemical research. Emphasis is on structural studies of triterpenoids, essential oils, and resins. Glycyrrizinic acid from Glycyrrhiza glabra macedonica has a cortisone-like action with about one-third the activity of cortisone. Triterpenoid alcohols with complex fused and bridged ring systems are being studied to ascertain details of structure. The essential oil of wild Daucus carota is receiving considerable study. Considerable variability is found, depending on the sample. Some oils have much beta-pinene, others contain only alpha.

The new crops research at the Komorov Institute of Botany is not oriented toward practice, but rather is theoretical in nature. No new annual crops with seed oil like castorbean are known. There is no production other than short rows of new plants in the botanic garden. No special recommendations can be made of particular species as new crops on the basis of present information at the institute.

U. S. GOVERNMENT PRINTING OFFICE : 1959 O - 523800